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PORCUPINE BOILER FOR HEATING HOUSES.

WILLIAM M. FRANCIS.

The heating apparatus here described is distinguished for its efficiency as well as small cost of installation; both matters of much importance. The coal consumption is exceptionally small, and any one familiar with threading and tapping will find no difficulty in constructing it in the size shown; directions also being given which will enable the dimensions for other sizes to be easily calculated. The readers of this magazine who are in want of a satisfactory heating system will find it to their advantage to consider well the merits of this one. For over ten years the plant here mentioned has given excellent service, at practically no cost for repairs during that time, a record which few systems can duplicate. The principle requirement in the work is, that all joints be carefully made and well fitted.

There is no rule for calculating the capacity of the heating apparatus required that will apply in all cases and suit every one's requirements. The amount of surface in a boiler to the cubic feet to be heated is variable as is also the radiating surface to cubic feet of house. The same radiators and boiler supplying heat to one family will be found satisfactory if 70° is the general temperature required but would not answer if 80° was wanted. The situation of a house in reference to a hill, another house, or the manner in which it is built, are all factors which enter into an estimation of the capacity a plant should have.

From the experience of others, and an average of a number of rules, a safe rule is established which, to a great extent, is followed in practice; i. e. allow one square foot of heating surface of boiler to 600 or 700 cubic feet of house to be heated, and one square foot of radiating surface to 100 cubic feet to be heated. A poorly built house will require more, and a well built one somewhat less than above.

As a basis to work on, a piece of 1″ pipe is about 3.92″ in circumference on the outside, and as there are 144 square inches in a square foot, then $\frac{144}{3.92}=36.7$ inches, the length that a piece of 1″ pipe will have to be in order to get one square foot of radiating surface. Walworth pipe radiators, although not quite 3′ high, with the surface of the base and bends, are estimated as giving one square foot to a pipe; thus a certain number of pipes is the same number of square feet of surface.

The boiler capacity is calculated as follows:—

In the boiler illustrated we have 120 pieces of pipe 9″ long; then $\frac{120\times9}{36.7}=32$ square feet of heating surface, (leaving out the surface of the 8″ centre pipe). This is heating two floors with 9′ ceiling; 32′ x 20′ x 18′=11520 cubic feet, and $\frac{11520}{32}=359$ cubic feet to heat to one square foot of boiler. But if we allow that only two thirds of the pipes are effective in the boiler, then we have 540 cubic feet to heat to one square foot of boiler, which is still within the rule given.

In the radiators used to heat the above mentioned area the pipes have 108 square feet; then $\frac{11520}{108}=106$ cubic feet to be heated to one square foot of radiator, which is nearly in accord with the rule given. I would, however, recommend that the boiler be made 6″ or 8″ longer than the drawing and more tubes put in.

There are several ways that a larger boiler may be made; the one just given, and by using two doors for firing, the 8″ pipe is extended downward so that it is in contact with the fire, leaving out one row of pipes for this purpose. In large boilers of this type the centre pipe is extended clear through the grates and rests on the foundation, supporting the whole boiler. In this case a special grate and several doors to manipulate the fire, are required.

Another way of securing additional capacity is to make the radial pipes longer, and with the limited head room generally found in a cellar and ample floor space, this is probably the better way, provided a suitable iron top for the brick work can be found. There need be no fear that the longer horizontal pipes will make a crackling noise as the pipes will have a free circulation.

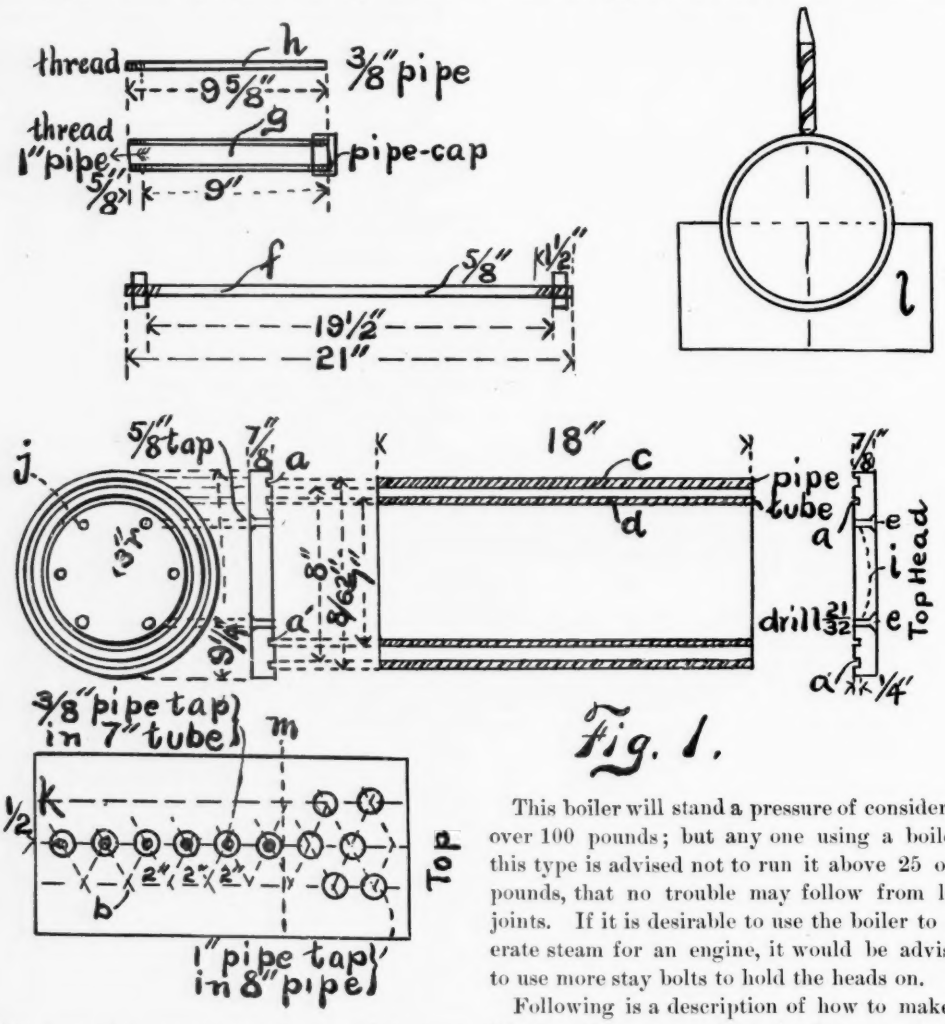


Fig. 1.

This boiler will stand a pressure of considerably over 100 pounds; but any one using a boiler of this type is advised not to run it above 25 or 30 pounds, that no trouble may follow from leaky joints. If it is desirable to use the boiler to generate steam for an engine, it would be advisable to use more stay bolts to hold the heads on.

Following is a description of how to make the boiler. First, get a piece of 8″ steam pipe, 18″ long (piping is gauged by internal diameter, tubing by external) which, as a general thing now is steel, also a piece of 7″ steel boiler tube, external diameter, the same length, (See c and d, Fig. 1). These, when cut off in the pipe machine, may have ends which are good enough fits, but it would be well to smooth them off a little by putting some

lamp black and oil, or red lead and oil, on a surface plate, rubbing it on smoothly with the palm of the hand. Try the ends of the pipes on this, rubbing them back and forth and, on examining the end, if there are only spots that are blackened these should be filed down and tried again until a fairly good bearing is obtained. The face plate of a lathe will answer if a surface plate is not to be obtained. If there is not much end play in the pipe machine, the ends may be faced true enough, after cutting off, to remove any holes that may be torn out by the tool jamming while cutting, but even then it is as well to try the ends on a face plate.

Next obtain two castings like e, Fig. 1, for end plates, the patterns being easily made from a piece of pine board, sawed round and smoothed up; or get two blank flanges $9\frac{1}{4}''$ diameter, $\frac{5}{16}''$ or $\frac{7}{8}''$ thick. Chuck the castings or flanges true in the lathe, or if you have no chuck large enough, the holes j, Fig. 1 may be drilled first and then the piece can be bolted on the face plate. With a cutting off tool, bore out the grooves a–a′, $\frac{1}{4}''$ deep, the outer one so that the 8″ pipe can just be tapped in with a hammer, using a block of wood to drive on. The 7″ tube should fit in the groove loosely and have $\frac{1}{32}''$ end play when the ends are bolted on. The lower head holes should be so drilled that they may be tapped, and the bolts shown at f, Fig. 1, screwed through with a lock nut outside. The holes should be slightly countersunk on the outer side, that a few turns of asbestos wicking may be wrapped around the bolt before screwing the nut home.

The top plate is so drilled that the bolts will slide through freely. Besides being countersunk, the holes should be counterbored to receive the face of the nut squarely, and the nuts should be also slightly countersunk, or faced on one side, or a broad circle wide enough to receive the nuts cut on the face of end plates, or the whole face of the plate may be turned in the lathe. Next, take the 8″ pipe and lay out on its outer circumference 16 lines, equally spaced, as at k, Fig. 1. Space these lines off as shown at b, Fig. 1, so that the alternate rows are staggered. Prick the centres with a centre punch, and with a pair of dividers draw a circle around the centre the size of the outside of the point of the tap or the size of the bottom of the thread on the 1″ pipes. These are to be drilled this size, $1\frac{3}{16}''$. The line, drawn with the dividers around the centre, is a guide in drilling, showing which way to chip if the drill works off the centre.

Before drilling, cut the $\frac{3}{8}''$ bolts f, Fig. 1, screw the long threads through the bottom plate and put on the lock nuts. Stand this end on the floor and put some pieces of card board in the 7″ groove; stand the pipe and tube in their place and put on the top head, screwing up the bolts so that neither the inner or outer pipe will turn while being drilled. Saw half circles in two pieces of 2″ plank, like l, Fig. 1, to fit the outside of the 8″ pipe. Put these on the drill platen and lay the boiler on them. Drill all the $1\frac{3}{16}''$ holes in the 8″ pipe with a twist drill and run the point of the drill into the 7″ tube in all holes five eights of the way from the bottom, or to the line m, Fig. 1. This will make it easy to start the $\frac{3}{8}''$ pipe tapping drill in the 7″ tube. Change drills and drill the $\frac{3}{8}''$ pipe tap holes through the 7″ tube. In drilling all holes in the 7″ tube, care should be taken to get them exactly centred in the holes in the 8″ pipe, and when they are tapped, a centre in the spindle of the drill press should be used, to start the tap fair. If this is not attended to, it will be difficult to get the outer radial pipes in place, after screwing in the inner $\frac{3}{8}''$ pipes. The top and bottom hole in one of the rows should be drilled through the 7″ tube, as shown at n, Fig. 2, for the inlet and outlet pipe. The inner tube is now removed and about 100 $\frac{3}{16}''$ or $\frac{1}{4}''$ holes are drilled in it, as shown at o, Fig. 2, in the space left between line m and the top, Fig. 1. If the boiler is to be used for hot water, all the 1″ pipes should have an internal pipe in them, the 7″ tube should be made about $\frac{1}{2}''$ shorter, and the top head turned out as shown by dotted line i, Fig. 1, and a hole large enough for the main pipe tapped in the centre so that if the boiler made steam it would escape freely; otherwise it would make a rumbling noise.

The boiler here given has eight more pipes than in mine and requires 128 1″ pipes $9\frac{3}{8}''$ long, threaded at both ends, (See g, Fig. 1), and about 80 of the $\frac{3}{8}''$, threaded on one end, (See h, Fig. 1). To save time, these pipes were purchased all cut and threaded. Care should be taken when taking

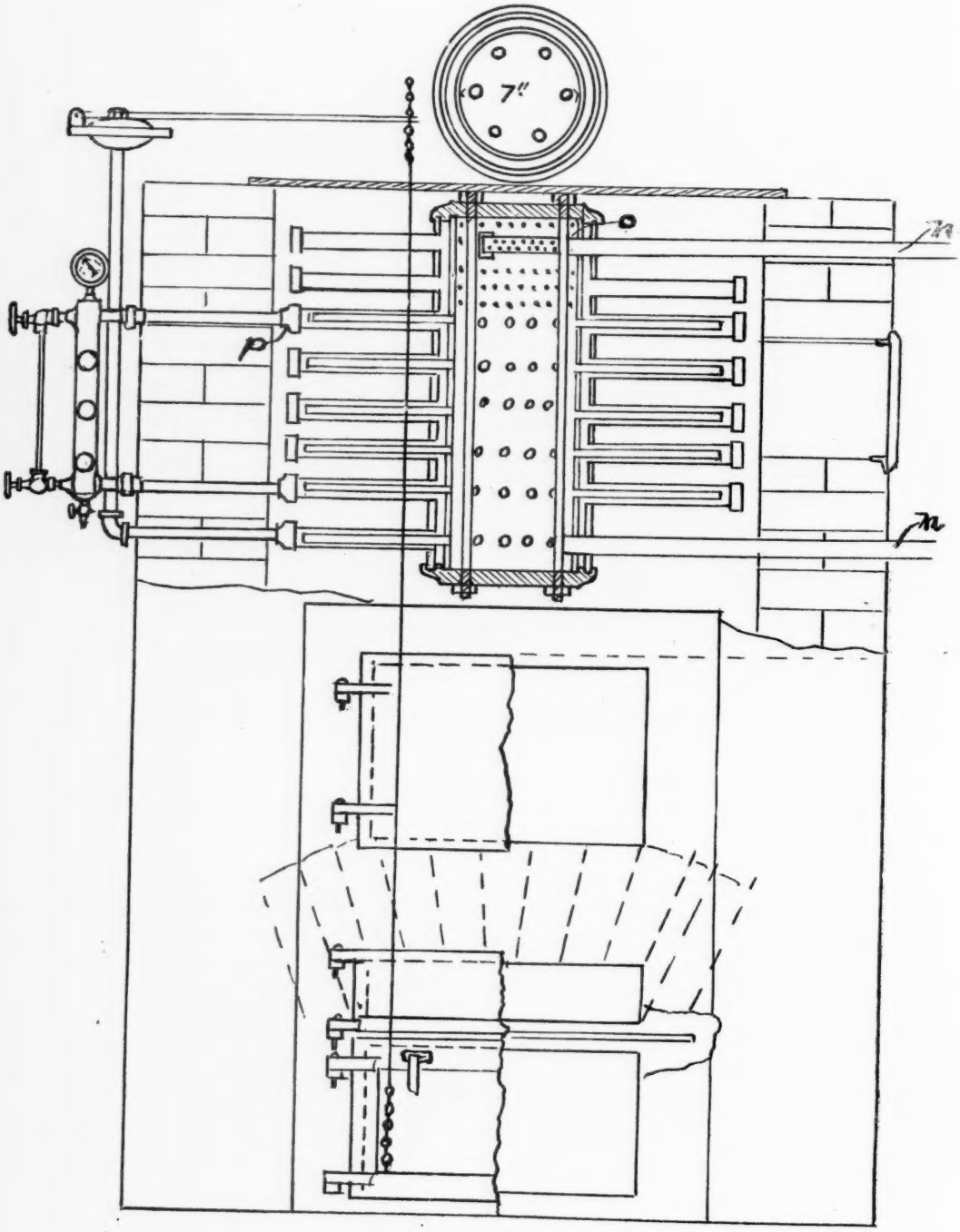


FIG. 2.

the boiler apart after drilling, to mark the position of the two pipes, that they may be put back in the same way, otherwise the holes may not match.

After the burrs around the holes have all been removed inside and out, and everything cleaned up, the 7″ tube is again inserted in the 8″ pipe and all the $\frac{3}{8}$″ pipes screwed into place. Screw in, also, the inlet and outlet pipe, as shown at n, Fig. 2. The outlet pipe is capped on the inner end and a number of small holes drilled in it. Cut a strip of asbestos, for each head about $\frac{1}{16}$″ thick, so that they will lay in the bottom of the 8″ groove nicely, and slightly lap the ends. Soak them in thin paint made of boiled linseed oil, red and white lead mixed, free from lumps. Insert one in each 8″ groove (top and bottom head) and put on the heads. Take a little asbestos wicking, soak it in red lead paint and wind it on the bolts close to the heads. It is better before doing this to drive the heads down all you can with a block of wood. On the top bolt ends, use a washer over the wicking, put on the nut and screw up firmly all around, giving it an occasional blow with a block of wood.

Now screw in all the 1″ radial pipes, painting the threads of all the joints with red lead paint and screw on all the caps. The pipes that are to make the connections to water column and diaphragm should be now located as near as possible and, instead of caps on the ends, use reducing couplings, as shown at p, Fig. 2. Plug all, except one outlet, from boiler and, to this, connect some steam connection and turn on a little steam. As it warms up, follow up on the bolts and replace any caps that have blow holes in them, and let steam remain on until the lead in the joints is hardened. The joints in my boiler made in this way have, up to date, stood ten years without leaking and have had 30 pounds of steam on them several times.

The cost so far for material is as follows: —

8″ pipe and 7″ tube and labor	$4.50
120 pieces 1″ pipe $9\frac{5}{8}$″ long 80 " $\frac{3}{8}$″ " " "	5.00
Cast iron flanges 33 pounds, $3\frac{1}{2}$ cents	1.05
10 dozen 1″ pipe caps $2\frac{1}{2}$ cents	3.00
12 nuts	.25
6 bolts	1.50
Sundries	.70
	$16.00

In the concluding chapter the trimmings, doors, grates, and brickwork will be described.

HOW TO MAKE A TELEPHONE.

Newman H. Holland.

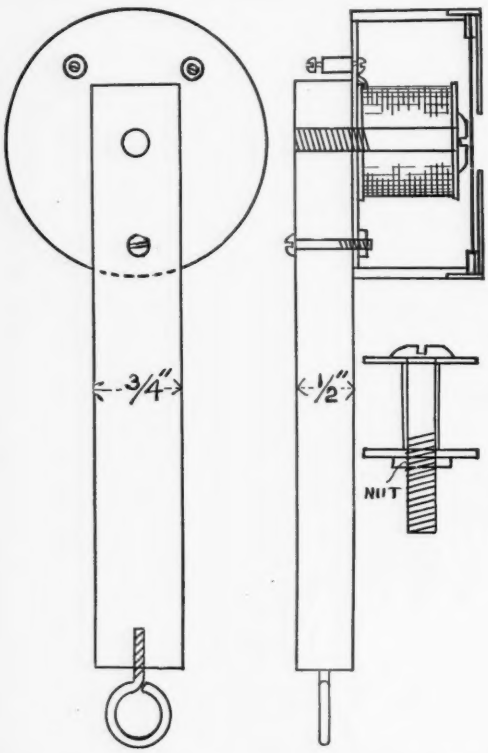
III. THE RECEIVER.

In constructing the transmitter, we made an instrument which changes sound vibrations into electric impulses. We will now make the instrument which re-converts the electric impulses back to sound, just as it was received at the diaphragm of the transmitter. There are a great many forms in which this part of the apparatus is constructed. The form here described, although not familiar to most of the readers of this magazine, is a very convenient one to make and much used in Europe.

The coil for this receiver can readily be formed on a 10–32 machine screw, 1 1-2″ long. Cut a round disk of thick cardboard, 1″ in diameter, with a hole in the centre just large enough to allow pressing lightly onto the screw until snug against the head. Then wind a ribbon of note paper about $\frac{5}{8}$″ wide, three times around the shank of the screw and as close to the card board disk as possible. Fasten firmly with glue. Then put another card board disk over the screw, bringing it up snug against the paper coil, and fasten in place with a nut. Do not jam the nut too tight. On the spool then formed, should be wound about 1000 turns of 36 silk covered magnet wire.

The box, to hold this spool, and also to retain the diaphragm, can be formed out of a cylindrical ointment box such as are used by druggists. A suitable size for the box is about $2\frac{1}{4}$″ diameter and 1 1-2″ deep, but this size need not be closely followed. For the handle a piece of bar steel 6″

long, and 3-4x1-2″ will be used, which will also form the permanent magnet necessary in all receivers. There are special grades of magnet steel on the market which would be preferable to use, but any good tool steel should retain sufficient magnetism for the purpose. A hole should be drilled 1-2″ from one end which will tap for a



10–32 screw (No. 20 drill). About 3-4″ from this hole drill another with a No. 27 drill, to receive without threading a 6–32 screw. In the other end of the steel bar, drill a hole into the end, of a size to receive an ordinary screw-eye. As this has a thread for wood the hole cannot be tapped to fit, so no threads are cut, but the screw-eye is forced in by driving.

The steel bar must now be hardened and magnetized. To harden, it should be heated to a bright red and then quickly plunged into cold water. This can more conveniently be done at a black-smith's shop. The magnetizing can probably be done at the nearest electric light station on the field of one of the dynamos. It makes no difference which end of the bar is the north pole.

The receiver shell or box can now be attached to the magnet. First, bore a hole in the exact centre of the bottom of the box just large enough to clear the end of one 10–32 screw which forms the core of the coil. Placing the protruding end of this screw through the hole in the bottom of the box and then screwing it into the outer hole in the steel bar the three parts are fastened together. To keep the box from working loose, a 6–32 screw should be passed through the other hole in the bar, and another hole bored in the bottom of the box, and secured by a nut as shown in the illustration. Two small binding posts should now be mounted at the top of the box to which are attached the terminals of the receiver wires.

The head of the screw forming the core of the coil should be level with the top edges of the box, and if when assembled, this is not the case, the top edge of the box should be run over a piece of sand paper tacked flat to a piece of board, and the box ground down until all points are level with the head of the screw. The diaphragm should be a piece of tinned iron, using as thin a piece as can be procured. Two circular washers of card board 1-32″ thick and of the same outer diameter as the diaphragm, are needed. The inner diameter should be 1-4″ less, making a ring 1-8″ wide. One washer is placed below and one above the diaphragm and for convenience of assembling, can be glued directly to it.

A hole, 1-2″ in diameter is now bored in the cover of the box, and after laying the diaphragm and its washers directly on the rim of the box, the cover can be put on and fastened in place by gluing a strip of paper 1-2″ wide around the box centered over the joint between box and cover. This will keep the parts in proper position and yet allow repairs without much trouble in opening. Care must be taken to see that the diaphragm is perfectly straight and without buckles or jambs. Also, before finally putting on the cover, it is important to see that all dust and iron particles are removed from the box, as anything of this kind between the head of the screw and diaphragm would prevent the proper operation of the instrument.

STUDIES IN ELECTRICITY.

XIV. ELECTRIC LIGHTING.

The resistance which a current meets in a circuit and the heat resulting from this resistance has been presented in a previous chapter. It is also a fact that using suitable materials or gases this resistance may be made to develop light. If two carbon rods are placed with ends in contact, and a suitable current passed through them, upon separating the ends slightly, the current is forced across the air gap, the resistance of which creates a brilliant flame called the *electric arc*. The current necessary to this result is usually of 45 volts and 6 to 10 amperes, the latter being what is commonly spoken of as a 2000 C. P. lamp, though actually giving only 600 to 700 C. P. in the direction of maximum illumination and less at other angles.

The intense heat (about 3500° C) at the arc reduces the tip of the carbon rods to vapor and this carbon vapor, being a better conductor than air, serves to conduct the current across the air gap from one tip (positive) to the other (negative). The two rods are not vaporized at an equal rate, the terminal of the positive carbon being consumed at about twice the rate of the negative. The tip of the former is, therefore, the point of highest temperature and maximum light. After burning for a short time, the tip of the positive carbon assumes a cup shape termed the *crater*, and the negative carbon has a conical form, roughly corresponding to depression in the positive. The vapor thrown off by the positive carbon condenses in the form of graphite upon the surface of the negative carbon, the latter being at a lower temperature than the former. Because of the shape assumed by the tip of the positive carbon, and as the field to be illuminated is usually under the lamp, the positive carbon is placed above the negative.

As the lamp continues to burn and the consumption of the carbon rods proceeds, the space separating the tips increases and likewise the resistance until finally, were the carbons to remain in a fixed position, the current would eventually cease to flow and the light become extinguished. What is necessary, therefore, to secure a continuous light is some device for constantly keeping the tips of the carbons at a suitable distance from each other. The arc lamps used for street and store lighting are therefore equipped with automatic arrangements for feeding the carbons towards each other as fast as the consumption at the tips makes this necessary.

The action of the regulator may be frequently observed, as well as certain peculiarities accompanying it. A hissing noise is given off following a movement of the regulator which indicates that the space between tips is too little and a too rapid vaporization of carbon follows. If the strength of the current is greater than the normal capacity of the carbon or the length of arc used, hissing follows, which may become quite loud if the current is very excessive. If the air space is correctly adjusted to the current and the feed regulation is sensitive, the arc burns quietly and evenly. If the space is too great, the arc flames, the carbon is consumed rapidly, and the light greatly decreased.

The carbon rods used in arc lamps are generally composed of retort carbon ground very fine and mixed with molasses, coal tar, or some similar liquid hydo-carbon as a binder to make the powder into a paste for moulding into the proper form. They are then placed in a retort and baked under high temperature for several hours, and then generally electro-plated with copper to secure better conductivity. Carbons with a core of softer carbon are also used, the crater in such rods remaining in the centre and burning more evenly than the others.

A form of lamp known as the "Enclosed Arc" has lately come into general use. Around the carbon rods is placed a small elliptical glass globe which is firmly fastened to the lower carbon. A washer is placed over the upper opening which has a hole large enough to admit the upper carbon. Only a small body of air surrounds the

carbons, and this, when the lamp begins burning, is quickly replaced with a hot atmosphere of nitrogen and carbon oxides. The absence of oxygen in the globe prevents the rapid consumption of the carbon; the air gap and voltage can be increased and the current cut down to admit 5 amperes. The lamp, instead of requiring daily renewals of the carbon, need attendance only about once in ten days, making the cost of maintenance much less.

Where alternating currents are used for arc lighting, the reversals are so frequent as not to be perceptible to the eye. As the carbons alternate in being positive and negative, there is no crater formed and the consumption of the rods is about equal; the upper one, when placed vertically, being about ten per cent greater owing to the heat of combustion rising around it. Soft cored carbons are used with alternating currents, both to maintain an even arc and sufficient carbon vapor to convey the current which must cross the air gap with each reversal. For this reason, alternating current arcs require a somewhat greater current than for direct current arcs; usually about 15 amperes and a drop of 35 volts across the arc.

In the incandescent or glow lamp, a solid conductor of high resistance is heated to a state of incandescence by the passage of the current through it. A carbon filament carries the current and would be instantly consumed with the first passage of the current, were it not sealed in a glass globe which has been exhausted of all air. The filament is attached to leading in wires of platinum which are sealed in the glass. This expensive metal is used as it is the only one so far discovered which expands and contracts at the same rate as glass thereby preserving the vacuum. The outer ends of the platinum wires are connected to the globe terminals, usually an outer threaded brass ring and a centre end ring. When placed in the lamp socket and the switch opened, the current passes around the filament heating to incandescence.

The manufacture of the filaments is a complicated and delicate process, the size and finish being determined by the voltage, size of lamp, and candle power wanted. An incandescent lamp should never be used on a current of higher potential than that for which it is rated. The usual potentials for incandescent lighting are 55, 110, and 220 volts. In use, the filament of a lamp gradually wears away and is deposited in minute particles on the inner walls of the globe. The diameter of the filament is thus reduced, the resistance and consequent heating increased, until eventually the filament breaks. It is often desirable to replace a globe which has been long used with a new one, as the old lamp is very liable to consume a quantity of current out of proportion to the light given. The life of a standard 16 C. P. lamp runs from 600 to 900 hours, but any lamp which gets very hot, even if giving a fair light, should be replaced with a new one.

WATERPROOFING CLOTH.

Cloth may be rendered waterproof, according to *The Druggists' Circular and Commercial Gazette*, by rubbing the under side with a lump of beeswax until the surface presents a uniform white or grayish appearance. This method, it is said, renders the cloth practically waterproof, although still leaving it porous as to air. Coating the under side of the cloth with a solution of isinglass and then applying an infusion of galls is another method, a compound being thus formed which is a variety of leather. Another and easier method is the formation of aluminum stearate in the fibre of the cloth, which may readily be done by immersing it in a solution of aluminum sulphate in water (1 to 10), and without allowing it to dry passing through a solution of soap made from soda and tallow or similar fat, in hot water.

If the experiments now being carried on by Mr. Marconi in Cape Breton are successful, stations with his wireless apparatus will be established at Cape Race and Cape Pine, on the southern seaboard of Newfoundland, and at Cape Bauld, on Belle Island Strait, to aid steamers and fishermen in traversing the danger zone along the Newfoundland coast. The system will also be extended to Labrador for use by the fishing fleet during the summer season. The Labrador service will be a great boon to the fishermen, about 20,000 of whom visit that peninsula every summer in quest of cod.

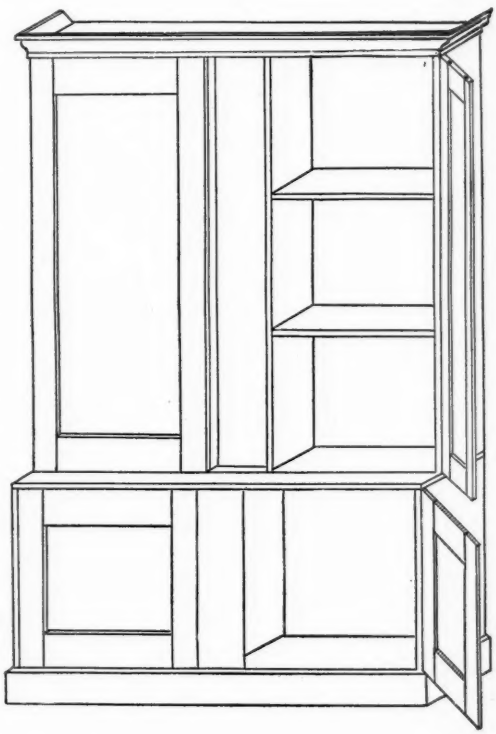
CABINET FOR A BOY'S ROOM.

JOHN F. ADAMS.

I HAVE been requested to give directions for making a cabinet for a boy's room, suitable for storing the numerous possessions so dear to the average boy, who generally has to make use of odd corners and furniture not wanted by other members of the family. At the same time, the cost of construction must be very moderate, only ordinary skill required of the maker, and ample capacity in the finished product. While this is a problem of no small proportions, the directions to follow will conform to the above conditions and enable the reader to produce a serviceable piece of furniture.

The materials required are: four shoe packing cases of uniform size, one case made of thin ($\frac{1}{4}$″) wood, a little moulding, hinges, etc. The shoe cases can usually be obtained of any shoe dealer, though one may have to wait to get them all of one size. They should also be cases in good condition, without knot-holes, cracks or broken joints. If possible, get one case made of a number of narrow even strips for the purpose of having as many grooved pieces as can be obtained. Even then an additional case may have to be used.

The illustration shows the general plan of construction. One case, with well made ends, forms the lower compartment. This is raised from the floor about $3\frac{1}{2}$″ by nailing on strips 4″ wide, as shown. The joints are mitred and the top edges beveled on the outer edge. Two cross strips and a back piece are nailed to the under side of the box to give added firmness to the support. The ends of two boxes are then sawed off as close to the nail holes as possible, this being done to give a better appearance to the sides. Be sure that in sawing the cut is square with the edges. Also cut off one side of each box so that the cupboards to be formed by them will be 12″ in depth. The ends are used for shelves, so do not break them when sawing. Nail the shelves in position, the proper distance apart (about 12″). Then place them upon the lower case, with the outer sides flush with the ends of the lower case. Take one of the best of the covers and nail across the top of all the sides, using care that the two inner sides are the same distance apart at both top and bottom. Place the top upon the floor and the lower box on top of it, with the top downward, and nail the two firmly together. A few long screws would help make the frame more rigid.



Turn the frame back to the correct position and around the top nail a piece of moulding 2″ or 3″ wide of any suitable pattern. As the top part is somewhat less depth than the lower part, the backs are in line, leaving a narrow shelf at the front above the lower part. A long narrow space is also formed between the two boxes forming the upper part. This space makes an excellent place for ball bats, fish poles, etc. The lower box is

divided by a partition placed in the centre. In front of this partition and flush with the outer edges, put a piece of board the exact width of the narrow space just above it.

The doors are next to be made, and as they are panelled, may at first thought, seem a formidable undertaking. Here is where the many grooved strips and thin wood first mentioned, come in, to make an easy matter of what otherwise might require considerable work. Select four long clear strips for the side pieces of the upper doors and saw off any extra wood to bring them to a uniform width of 2″. Be sure not to saw off the grooved edge. Measure the depth of the grooves and outside width of the cases, and cut pieces for tops and bottoms of the doors, leaving enough wood to make tenons on the ends to fit the grooves in the side pieces. From the thin wood, cut panels to fit the doors, and put together with strong glue at the joints between sides and ends, but do not glue the panels. Make these doors a little large to plane down to an even fit to the outer edges of the cases.

The doors for the lower section are made in the same way, except that they fit inside the case. The door to the narrow recess above is a plain board, hinged to the side of the left case. The door is hung about ¾″ in from the doors on either side, and has the appearance of a panel rather than a door. The hinges should be small and concealed, thus forming a sort of secret cupboard. As there is no back for this recess, short pieces must be nailed to the boards at the top and bottom and a board nailed to them, forming the back.

The cabinet being made, a coat of lead paint is applied. When this is dry, all cracks, nail holes, etc., are filled with putty and it is then rubbed smooth with fine sandpaper. A coat of enamel paint of any suitable dark color is then applied and an attractive and useful cabinet is the result at a cost easily within the reach of all desiring to make it.

BOOKBINDING AT HOME.

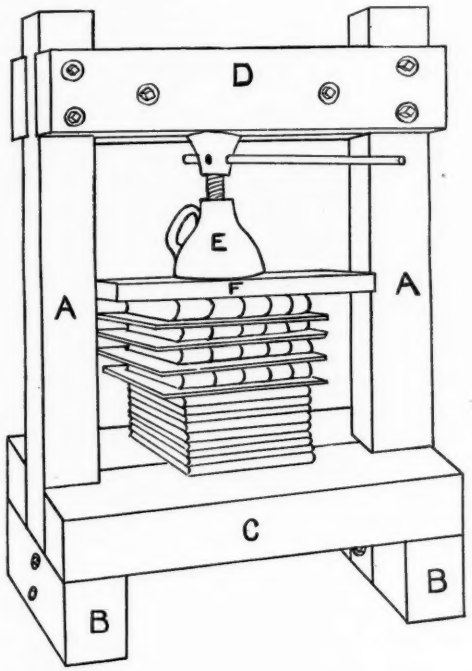
II. THE PRESS.

An important part of the process of binding books is the pressing which causes the leaves to lie smooth and compact for the subsequent operations. If the reader is so fortunate as to be able to find a large second-hand office copying press which can be purchased at a low price, such a press will be found quite adequate for a wide variety of work. As such presses are going out of use in office work, a little time spent in searching may result in the finding of a suitable press and the work of making one avoided. Any one who is obliged to make a press will find no difficulty in making the one here described. It is large enough for all probable requirements and yet not too heavy to prevent moving about as desired.

The frame is made of spruce or Georgia pine which is readily obtainable at any lumber yard. The upright pieces A are 30″ long and 3″x4″ stock. The pieces B and D are cut from the same size stock, the former being 16″ long and the latter 24″ long. The wider dimension of pieces B and D is perpendicular; of A, parallel with the ends. The joints are halved and strongly fastened with ½″ lag screws or bolts, washers being placed under the heads. It will be noted that there are two pieces D, the inner sides of which come together and are fastened to each other with two or three lag screws. The lower sides of these pieces are 24″ from the lower ends of pieces A.

The base C is made of 3″ plank and is 24″ long and 16″ wide. Two pieces of plank 8½″ wide are rabbetted on the inner edges with a rabbet 1″ wide and 1½″ deep. This can be done by lightly nailing narrow strips each side of a mark drawn where the cut is to be made and just far enough

apart to admit a back-saw. By sawing first one cut, and then the other, the rabbetting can easily be done. Any roughness is removed with a rabbet plane. The joint should be a good one, enough time and care being taken to obtain it. It should be strongly glued and held in clamps until the glue is well set. Before gluing, the two pieces are cut and fitted around the uprights A. When



ready, the base is firmly fastened with lag screws to the pieces B and the wood-work is complete. All that is required in addition is a piece of 2″ planed plank F, preferably of oak, 18″ long and 15″ wide, some smaller pieces ½″ thick and an ordinary jack screw E. The latter can be purchased of any large hardware dealer. The writer secured one at a junk shop for a very small amount. The method of using the press will be fully described when the work of book-binding is presented.

Cable advices state that English capitalists propose to build an electric railway from Brussels to Antwerp.

ALCOHOL MOTORS IN GERMANY.

The recent agricultural fair at Halle has shown the wonderful strides that Germany has made within the last eighteen months in alcohol motors, advises Oliver J. D. Hughes, Consul-General at Coburg. This is due to a great extent to the personal interest taken in the subject of the use and application of alcohol for trade purposes by the Emperor, and also to the low price at which this spirit for fuel purposes (containing about 90 per cent of pure alcohol) is furnished all over Germany—a quart costing only about 5 cents.

The great advantages of a spirit motor over the ordinary steam engine are that it is always ready for use, without preliminary warming up; it can be filled, oiled and started in from two to three minutes; there is no constant supplying of coal and water, and no danger of fire or explosion; no permits are required from Government authorities, and there is no compulsory inspection; the spirit is easily obtained in all districts; there is no smoke or smell; and the weight of a portable spirit motor is about one-half that of a portable steam engine of equal power.

In the test made by a large German firm that exhibited at Halle, one trial showed a consumption of 0.42 kilogram (0.92 pound) of 86 per cent spirit and 0.37 kilogram (0.81 pound) of a mixture of one-fifth benzol and four-fifths 86 per cent spirit, in both cases per brake horsepower per hour.

A large electrical generating station has jnst been opened in Southern India, just below the Cauvery Falls, which are on the borders of the Mysore State. They are situated in wild country, thirty miles from a railway. All the heavy machinery had to be conveyed over this distance by bullocks and elephants. The electrical power is conveyed across the jungles for a distance of over ninety miles to the Kolar goldfield, where all the mines will henceforth be entirely worked by it.

The absorption of small quantities of nitrogen by pure iron renders it hard and brittle like steel.

AMATEUR WORK

63 KILBY ST., BOSTON

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DECEMBER, 1902.

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THE VALUE OF MODEL MAKING.

THAT model making has a value far beyond the mere pleasure of the work is a fact that is realized by far too few of the young men of this country. Parents, who in a measure encourage their boys to "make something," have given but little time to helping the mechanical desires of their boys into useful chanels. This should not be. The boy who has reached an age and experience when he can handle the more common tools with a reasonable degree of skill should be encouraged to attempt some line of work requiring time, study, and moderate skill to perfect. A small steam or gas engine, a model locomotive, an electric motor or dynamo are but a few of the many subjects which can easily be worked up, yet how few are there who produce anything really creditable in this line. The necessary instruction and materials are now easily obtainable, and would be more in demand if the practical value to be derived from such work was more generally realized. As an example, may be cited a student in one of the schools of this city, who took up model engine construction for the pleasure it afforded him. The instruction he received through it enabled him to pass the necessary examination and obtain a license as second class engineer. Two summer vacations have been spent at a well known summer resort in running a steam launch for which he was well paid. Instead of being obliged to depend on the parental purse for vacation funds he enjoys the fresh air and healthy surroundings of the country, returns to school invigorated in body and a substantial sum earned by his own labor. Not only has he acquired mechanical skill but also a considerable knowledge of business methods and conditions. Similar examples can be given but the number is proportionally much too small.

Model making is one of the best ways for acquiring the knowledge necessary to more practical work, and this magazine will shortly present a series of articles especially designed for readers interested in this line.

The strike of the electro-engravers has prevented the securing of illustrations for two important articles which were to have been published in this issue.

WOOD TURNING FOR AMATEURS.

F. W. Putnam, Instructor Manual Training School, Lowell, Mass.

IV. TURNING THE CYLINDER.

Having made sure that the lathe is in good running order, we are ready for our first exercise, the turning of the cylinder. For this we will require a piece of pine stock 2″x2″x9″ in length. Make sure that the stock selected is dry, and free from knots.

Place the fork centre in the head-stock and the cup centre in the tail-stock. The block must first be "centred." There are several ways of finding the centres of the stock to be turned, of which the following are the simplest. Find the centre of the ends by drawing diagonal lines from the corners, as shown in Fig. 18; or by setting the dividers to nearly one-half the thickness of the stock, and then, resting the faces of the block in succession on a flat surface, draw lines as shown in Fig. 19. The latter method is especially good if the stock is irregular in shape as shown in Fig. 20. The centre of the small figure may be easily guessed, or the diagonals drawn. In either case the point found will be nearly the centre required.

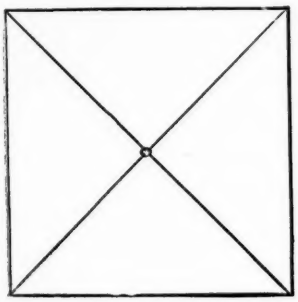

Fig. 18.

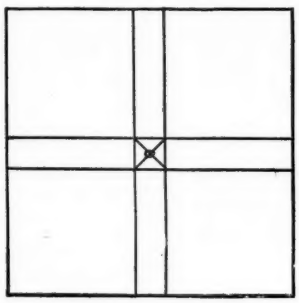

Fig. 19.

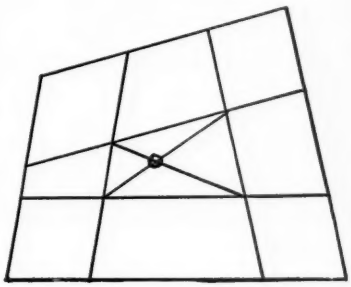

Fig. 20.

After "centring," place one end against the spur of the fork centre, and force the wood against the fork with a few blows from a mallet until the "wings" of the fork centre get a good grip. Draw up the tail-stock and clamp it tightly in place within an inch or so of the end of the stock, first making sure that the tail spindle has been drawn nearly all the way back by means of the hand wheel. Next hold the right hand end of the block in the left hand, and turn the hand wheel until the centre point of the cup centre has been forced well into the end of the stock, being sure that the point enters the wood at the centre just found. Clamp the tail spindle in place, and drop a little oil at this centre, as the wood revolves while the centre remains stationary, and a little oil or grease will materially reduce the friction. The pressure of the cup centre against the wood can be tested by pulling the belt by hand.

It is a good plan to make a little hole in the centre point with a nail, before the stock is put into the lathe. If the cup centre or dead centre is forced too strongly against the wood, so much heat will result that a squeaking noise will soon be heard, caused by the friction between the cup centre and the wood. If this occurs, loosen the cup centre a trifle, and use a little more oil.

Before starting the lathe, clamp the tool rest in place, with its edge slightly above the centre line of the lathe and as near as possible without touching the wood. Pull the belt by hand to make sure that the stock and the tee do not touch. Thoroughly oil the bearings of the head-stock before starting. There is always a reason for the heating of a bearing and it is important that the

lathe bearings should always be well oiled.

Next start the lathe. For this and similar exercises the belt is run at its highest speed, that is, the belt is run on the smallest step of the headstock pulley. For heavy work between centres the speed ought to be slower by one step of the cone pulley when the work is started and until it has reached a circular shape. One of the first things tc be mastered is the shifting of belts. When the belt is to be changed to another step of the cone pulley, it must first be "shifted" to the smaller and then to the larger of the steps on which it is to run.

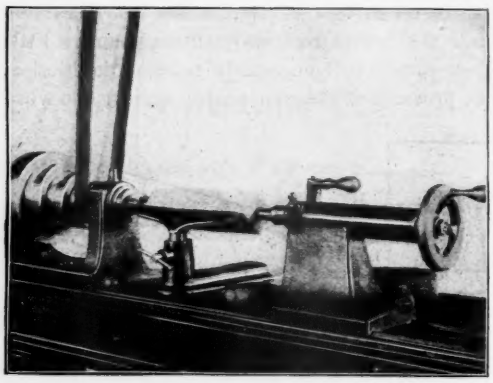

Fig. 21.

In stopping the lathe, after the overhead belt has been "shifted" to the loose pulley, the hand may be placed against the steps of the cone pulley, but care must be taken not to catch the fingers or sleeve under the belt. Do not wear loose sleeves, as there is danger of their being caught either in the belt or between the tee and the work.

Fig. 21 is taken from a photograph, and shows the block and the rest in position ready for the starting of the lathe. It will be noticed that the tail spindle has been drawn nearly all the way back. This is advisable, that there may be no possible chance for the spindle to "give" or vibrate. This would hardly happen with small blocks, but in the turning of a piece of stock say 5″x5″x15″ in length, there would be a noticeable vibration if the tail spindle were drawn out nearly its full length. The stock is now to be turned to a rough cylinder by means of the 1½″ gouge.

Position of the Gouge.

The general position of the hands when using the gouge is shown in Fig. 22. The left hand grasps the gouge firmly, the knuckles of the fingers being uppermost and the fingers beneath. The

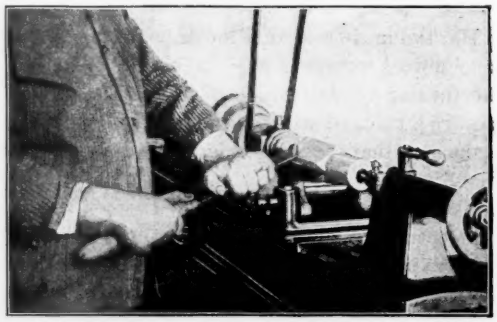

Fig. 22.

end of the handle is held firmly in the right hand, which is pressed lightly against the side of the body. If the handle of the gouge is long, I prefer for "roughing out" the stock to grasp the handle with the right hand so that the thumb bears on the ferrule. The left hand presses the gouge firmly on the rest and moves the cutting edge along the work, the depth of cut being regulated by this contact with the rest. It will be noticed that the right hand is held somewhat lower than the rest.

The gouge must be gradually advanced toward the revolving block on the angle shown in Fig. 23. This angle is called the "tangential angle." When the cutting level is exactly a t ngent to the circle there can be no cutting action its position being that at which the tool has ceased cutting. Raise the handle of the gouge slightly until the cutting takes place. Start a light cut near one end of the wood and carry the cut out to the end of the block. Start a second cut in the middle of the stock and carry it to the end also, rolling the gouge slightly with the right hand. Repeat the cuts until all the corners have been removed and the stock is round. The gouge must be slightly inclined *toward* the smaller diameter to avoid catching in the grain and thus splitting the wood. Be sure that the tool is held steadily during this operation as there is a constant tendency, because

of the rotation of the work, to force up the right hand of the operator, thus causing the cutting edge of the tool to catch and dig into the wood. The end of the rest should extend beyond where the cut is to end. If the rest is not long enough, it

FIG. 23.

must be moved back and forth as occasion requires. In every case, *stop the lathe. Never adjust the rest when the lathe is in motion.*

When the stock has been roughly turned to a cylindrical form, and the rest has been moved a little nearer to the wood, the gouge is made to travel backwards and forwards with an even motion, that it may cut an even light shaving all along the cylinder. In this way bring the cylinder down to $1\frac{3}{4}$" diameter.

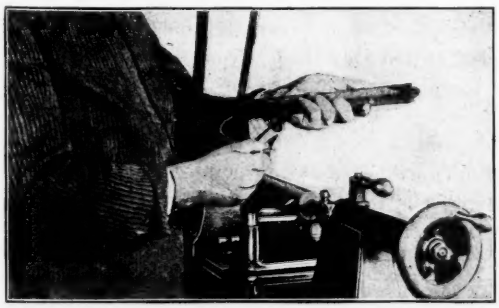

FIG. 24.

The diameter is measured between the points of the calipers, as shown in Fig. 24. The calipers are held in the right hand, with the rule or scale in the left hand, all measurements being made from one end of the rule. It is absolutely necessary for correct measurement, that the calipers should be applied exactly square to the work, so that the entire thickness of the blades of the calipers may bear upon the object measured. The calipers are held in the right hand and applied to the work as shown in Fig. 25. If this is not done, and the calipers are applied as shown at B, Fig. 26, the work cannot be accurately tested. There is

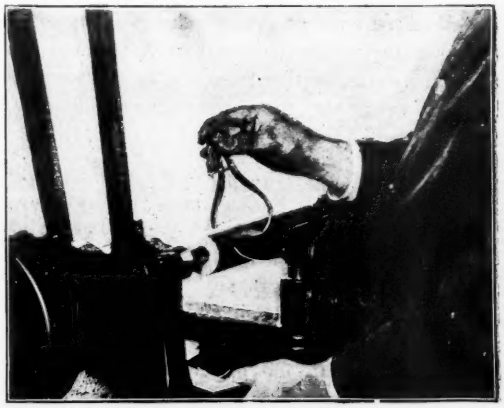

FIG. 25.

some elasticity to the calipers, and this may also be a source of error, if they be carelessly used, as they are capable of being forced over a diameter a trifle larger than that at which they have been set by the rule. For exact calipering, the points of the calipers must pass easily over the diameter to be measured, but with a sensible touch. Although they are set so that they will pass over easily, the hand will readily feel the contact be-

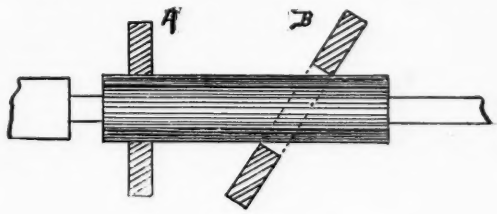

FIG. 26.

tween their points and the objects measured. The comparison of one diameter with another should depend entirely on this sense of touch. During the first few exercises it will be better to stop the lathe for all measurements with the calipers. After some practice, approximate measurements

may be made with the lathe running, but for final accurate measurements, always stop the lathe before calipering. In using the gouge the beginner must first learn that he is to *cut* the wood, not to scrape it.

Two general directions which follow from what has been said on the use of the gouge are:—First, cut, not scrape the wood. The tool should be well raised nearly to the "tangential angle."

Second, incline the tool, and work towards the *end* of the grain, cutting from the larger towards the smaller diameter, the gouge being rolled somewhat on the rest during the work.

Position of the Skew Chisel on the Cylinder.

In using the skew chisel on the cylinder, the rest must be set higher than when the gouge is used. The manner of grasping the chisel is very similar to that of the gouge, and its cutting action is the same as the gouge; but it is applied to the work in a very different manner. Fig. 27 shows very clearly the position of the hands in holding the skew chisel. It will be noticed that the skew chisel is held with the left hand on the blade near the cutting level, the fingers beneath and the knuckles uppermost.

Fig. 27.

The tool does not lie flat on the rest, but is tilted on the under corner of one side. The tool must first be held tangentially to the work, the chisel having good contact with the rest. In Fig. 27, the tool is held so as to cut towards the right. When cutting from left to right the handle must be swung back a little towards the left, so that the angle between the edge of the tool containing the obtuse angle and the block, will always be somewhat greater than a right angle; or, in other words, the obtuse angle will be always leading. The acute angle must be kept free from the work, as the cutting must be done either between the corners or at the obtuse angle.

If the entire width of the cutting edge be allowed to come in contact with the work, the tool would catch, as both corners would dig in, and

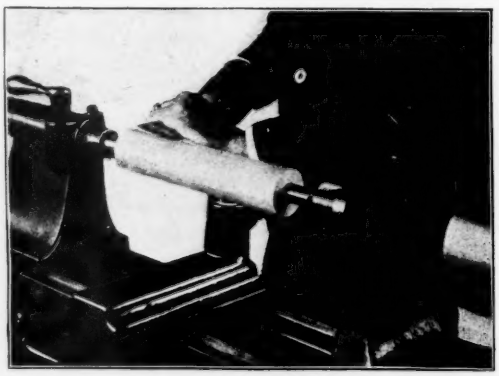

Fig. 28.

the tool become unmanageable. This necessitates, then, what is known as "clearance" between the surface of the revolving block and the part of the under level of the skew chisel that contains the acute angle; at the same time there must be a bearing surface between the under level of the chisel at, and for a little beyond, the cutting point, or the point will dig in, the tool not being held flat enough on the rest. If the tool be tilted, as I have said, on the under corner of one side, it will be in contact only at one point. This point may be either at the obtuse angle of the cutting edge, or from one-quarter to one-third up the cutting edge from this obtuse angle, depending upon the way the tool is brought against the work. In the first case, the cutting is all done at the obtuse angle; and, in the second case, both corners will be free from the work and the cutting will be done between the corners.

Either of these methods is perfectly accurate, although I prefer cutting at the obtuse angle. My reason is this:—If the method of cutting between corners is to be used, some difficulty will be en-

countered when the 1-4″ and 3-8″ skew chisels are used. These chisels are so narrow that in cutting "between corners" one is very apt to catch the acute angle of the cutting edge, and thus dig in. If the method of using the obtuse angle as the cutting point be followed, the amount of "clearance" necessary in the use of small chisels to escape the digging in of the acute angle can readily be determined, because of the practice gained in the use of the 1½″ and 1″ skew chisels.

The shape of the skew chisel, if properly ground, will aid greatly in finding its correct cutting position. The bevels of both sides of the chisel must be ground perfectly straight, and not allowed to become rounded over. The cutting line must also be perfectly straight, for, if somewhat rounded, the obtuse angle could hardly be made to cut first, because of a higher point farther up the cutting edge.

From the above, four things will be learned relative to the position of the skew chisel: —

First, the chisel must have contact with the rest;

Second, the acute angle must be kept clear of the work;

Third, there must be clearance between the under bevel and the work near the acute angle of the cutting edge;

Fourth, there must be contact or a bearing surface between the under bevel and the work near the cutting point, which, in our method of procedure, is to be the obtuse angle.

Most amateurs find it easier to use the skew chisel from right to left than from left to right. Hold the 1 1-2″ chisel as shown in Fig. 28, this view being given to show the clearance between the acute angle and the work. The position of the hands is the same as shown in Fig. 27, except that the arm, instead of coming against the body, is drawn somewhat away from it, in order to give the required obtuse angle mentioned above.

When the chisel is held tangentially with the under bevel bearing on the work, no cutting action will take place. The handle is then raised slightly until the edge cuts into the surface about 1-64 of an inch. Advance the chisel for a short distance towards the left. A smooth surface should be produced where the chisel cuts, and this smooth surface will serve as a guide to show the depth of the cut. Start the cut about 3 inches from the tail-stock end and carry it as evenly as possible to the other end. Next, turn the chisel over, taking the position shown in Fig. 27, the other bevel now being brought in contact with the surface The handle is this time drawn in towards the body; finish the cut to the tail-stock end of the block.

This work is to be repeated in both directions until the block is reduced to 1 1-2″ diameter from end to end. The surface, if correctly turned, should be smooth and free from lines or ridges. Care must be used in calipering; hold the calipers square to the work, and, when calipering as a final test, be sure that the lathe is stopped. If a rule or scale be placed along the edge of the cylinder, "high" places, that must be turned down, can readily be detected and marked.

An excellent authority on wood turning says: —

"With the use of the skew chisel the difficulties of the beginner may be said to commence, and these difficultie may be classed under three heads: first, turning a true cylinder; second, turning a flat surface, an operation which is usually termed 'facing'; and third, working accurately to measuremeuts." A careful use of a straight edge which will show at once what parts are "high" and need turning down, and a careful use of calipers in determining exact diameters will, I hope, overcome these difficulties to a great extent.

Do not hold the cutting edge too low down on the work, if you expect to cut a thin shaving. Do not give the chisel so much clearance that the cutting point will dig in. Do not cut against the grain, and do not expect to obtain a clean, smooth surface with a dull chisel.

NOTE: — The author desires to express his appreciation of the excellent work done by Mr. F. R. Woodward of the Lowell H gh School in the taking of the photographs used for the illustrations which appear in this and following articles.

NEVER put your fingers in the way of a machine for fun; in short, never play with a machine at all, it will not stand a joke.

FINISHING NATURAL WOOD FLOORS.

A. Irving McLaughlin.

The increased use of hard wood floors in all classes of houses in recent years has made the finishing of natural wood floors an important subject and one which is of interest to nearly everyone.

Floors to-day are usually laid with either rift pine, maple, birch, or oak, with sometimes strips of mahogany, walnut, or rosewood inlaid in parquetry floors. Pine, maple, and birch are close-grained wood and *do not* require a filler. Whatever finish is used on these woods should be applied to the bare wood. Oak, walnut, rosewood, and mohogany are open grained and should first have a coat of paste filler. This can be obtained in several shadings; light for oak, dark for walnut, and rosewood and mahogany for mahogany. Thin it down with turpentine or benzine and apply with a brush, rubbing it well into the grain. When it begins to set or dry it should be wiped off *across* the grain with a cloth. This leaves the grain filled and makes the wood ready for finishing when it is dry. There are four classes of material which can be used to finish natural floors, *i. e.*, oils, shellac, varnishes, and wax, and the floors should be prepared the same for all. Oils are better suited for kitchens and bath-rooms or large public halls, etc., where a high gloss is *not* desired and where it is necessary to scrub it often. Linseed oil mixed with a little turpentine and dryers is often used but the best thing of this kind is Revivol which is a light colored oil, and when applied with a cloth or stiff brush can be walked on in two hours. This will protect the wood and prevent the dust from rising when swept and is not greasy.

Shellac has only one virtue in connection with floors; it dries quickly so that the floor can be used within two or three hours after applying. It dries so hard that it is brittle, therefore scratches easily and is soon worn off. It also turns white when water stands on it, and is unfit for floors as ordinarily applied. If the very best grade of shellac is used, and the last coat rubbed with pumice and oil, it will wear and look much better than simply allowing it to dry. One of the best methods of finishing new hard wood floors is to apply two coats of a first class floor varnish, allowing twenty-four hours between coats and sandpapering the first coat lightly before applying the next coat. A varnish for floors should dry in at least twenty-four hours and be very elastic and not turn white when wet with water. One of the best floor finishes of this kind is Carmote, manufactured by Carpenter Morton Co. Boston.

This finish is made in transparent, which brings out the natural beauty of the wood, and also in five other shades, *i. e.*, light oak, dark oak, walnut, cocobola, and cherry. These stain and finish at the same time without in the least obscuring the grain of the wood. Carmote dries hard with a beautiful gloss, will not scratch white, and can be washed with warm water. Where an eggshell gloss is required, rub the last coat lightly with pumice and water. When washing up a varnished floor *warm water* alone should be used, as soap, ammonia, or washing powder rots the varnish and destroys its durability.

Wax should not be used on floors of kitchens or bath-rooms, as water will turn it white. On any other floors in the house, a good wax properly applied and taken care of is an ideal finish. A good floor wax should contain no parrafine as that makes it brittle and likely to chip off; or beeswax, as that makes it very slippery, and is liable to soften up in warm weather and be gummy. It should dry hard and take a good polish without very much labor, be smooth but not too slippery, and stay hard under all atmospheric conditions. The Old English Floor Wax, manufactured by A. S. Boyle & Co., Cincinnati, is one of the best wax finishers, and contains no parrafine or beeswax. It is put up in paste form, and should be applied with a cloth, spreading it evenly over the floor. After drying for fifteen minutes polish with a heavy weighted floor brush, rubbing first across the grain and then with the grain. For the final polish, use a piece of carpet under the brush which gives a fine finish. One of the advantages of wax over other finishes is the fact that where a floor is slightly worn it can be touched up with wax and polished without showing the patch, while with shellac or varnish it could not be done without showing plainly.

PHOTOGRAPHY.

PRACTICAL POINTS FOR BEGINNERS.

H. M. Albaugh, in "Bulb and Button."

You will understand that as far as exposure is concerned it makes no difference whether you are using a film or a plate camera.

Eastman films are of about the same speed as fast plates so that they need to be exposed the same length of time. The same may be said of fixed focus and folding cameras.

Right in the beginning let me say that you ought to have some system about this part of the work, and you will thereby save plates and avoid disappointment. You should provide yourself with a memorandum book and when you make an exposure note the subject, kind of light, time of day, time of exposure you give and stop used. I will just explain that the stop is the opening through which the light reaches the plate. I have met people who did not know their camera had any arrangement for regulating the opening. Some very cheap boxes have just one hole through which the light enters the box, but any camera worthy the name has a movable diaphragm so that the operator can change the opening at will. You will understand that if the opening, or stop, as we will call it, is large, it will require less time for the light entering to impress the image on the plate; so if you wish to take a picture instantly you must use a large stop. You will have to find out by experience just how much you can stop down for a given subject. By using a smaller stop you get better definition and lengthen the field of focus, so that generally speaking you should use as small a stop as possible. (This, of course, does not apply to the fuzzytype picture some of our camera experts make. I am writing these notes for the beginners who wish to get pictures their friends will recognize and admire.

As I was saying, you should keep a record of the exposures you make and then you can improve on each one until you become perfect. By all means number your plate holders so that you will know just how you exposed the plate, when you take it out of the holder to develop it.

Another very valuable help is an exposure meter. They are all good, I guess, but I am rather partial to one made by the Expodak Company, of Charlottesville, Va., called the "Cheape Exposure Meter." It is very simple, and I think quite accurate. It gives the correct exposures for any subject from dark objects in which detail is required, up to light clouds which we all know require the shortest exposure of anything we photograph. It gives a grouping of plates, telling you what plates are of approximately the same speed. It shows the time to give for any stop, from the largest to the smallest, simultaneously. And it gives the time of exposure for any day of the year and any kind of light.

An exposure meter will help you to time your plates better than anything else you can use.

There are two ways of taking pictures; holding the camera in the hands and giving an instantaneous exposure, usually called a snap shot; and resting the camera on something so that it cannot move—usually a tripod—and giving a time exposure. You will understand that if the camera is moved, even the least bit, while the shutter is open, or if the subject you are photographing moves while the shutter is open, your picture will be blurred, and consequently spoiled. Therefore, never try to take anything in a poor light by holding the camera in the hands; nor try to take a moving object in poor light where a time exposure is needed in order to get a picture.

Some people have the erroneous idea that in order to take snap shots you must have a fixed focus box camera, or kodak. This is all wrong; the beginner might get better results with the simpler outfit—but with a little practice you can take snap shots with a folding camera almost as quickly as with a kodak, and you can get results with the former impossible with the latter. A little practice will enable the operator to change the indicator on the focussing scale very quickly, and if you possess a good idea of distances you will have no trouble with your pictures being out of focus. You will have to do more or less experimenting, but my advice to you is, find out all you can about a thing from those who have been over the ground and then you can make your experiments intelligently.

EFFECTS OF ROENTGEN RAYS.

The skin disease called radio-dermatitis, caused by excessive exposure of the skin to Rœntgen or Becquerel rays, has been carefully studied by Dr. Oudin. The malady is painful and difficult to cure. The first symptom of acute and deep-seated radio-dermatitis is a reddening of the skin, which appears twenty-four to thirty-six hours after exposure. For from ten to twenty-five days the skin becomes cevered with small vesicles and itches violently, and at the end of this period it begins to peel off. In more serious cases, ulceration may set in and last for months. No treatment has been found capable of stopping the development of the disease, though applications of cocaine or orthoform dressings give some relief. Red-light treatment appears to accelerate the course of healing. A chronic radio-dermatitis frequently attacks the operators, affecting especially the fingers, which become red and swollen. This can be prevented by the use of gloves containing a wadding of very fine brass wire. To protect his patients, the author uses fairly strong rays and short exposures, gradually increasing in duration. For difficult radiographs he gives an exposure of thirty seconds at the first sitting, one minute two days afterward, and so on until the exposure is increased to three minutes. The tube is held five centimetres from the skin. The exposure can be gradually raised to five minutes, but this must not be surpassed.—*Archives D'Electricite Medicale*..

Mica possesses the highest insulation resistance and the largest dielectric strength to be found. It requires 1,000 volts to perforate a sheet one mil in thickness. Its chemical constitution is unaffected by high temperatures.

A circular mil is a circle one one-thousandth inch in diameter. A wire one foot long and one circular mil cross-section is called a mil-foot.

A German inventor, it is reported by Oliver J. D. Hughes, Consul-General at Coburg, has discovered a method and constructed an apparatus which obviates the drawbacks formerly encountered in the preparation of milk powder. The apparatus evaporates milk to complete dryness at a temperature not exceeding 40° C. and without the application of a vacuum. The powder obtained, it is claimed, has the fineness of flour. Neither the taste nor the odor of the milk is altered. Heated with water to from 60° to 70° C.—i. e., to a temperature exceeding the melting point of butter fat—milk is reproduced which, on cooling, differs in no way from ordinary milk. By a special treatment, the inventor says he has succeeded in preventing the powder from turning sour; it withstands bacteria, mold, dampness and changes of temperature. About 1 pound of powder is said to be obtained from 5 quarts of milk. The apparatus is easily manipulated and is capable of treating at least 2,600 gallons of milk per day. A sample of the powder obtained from skimmed milk, it is said, was found to contain 30 per cent albuminous matter, 49 per cent lactic sugar, 1 per cent fat (30 per cent in unskimmed), 7½ per cent salts and 6½ per cent moisture.

It was recently reported that a large sum of money was to be expended in developing the water power of the Maguadzi River, in South Africa. The output of the plant will be fourteen hundred horse-power.

Africa is rich in large waterfalls. One of these, the Victoria Falls, on the Zambesi River, is the largest in the world, being even larger than Niagara. It is about a mile wide and four hundred and twenty feet high. Even in dry seasons the water is from two to three feet deep at the crest of the fall. It was reported last spring that a project was under way for developing this magnificent cascade.

Before many years, we may expect to see large centres of industry spring up within the neighborhood of these immense waterfalls. South Africa promises to take an important place among the manufacturing countries of the world.

A SIGNAL TELEGRAPH SYSTEM.

A. G. Holman, M. E.

II. LONG DISTANCE APPARATUS.

In the first article (October, p. 296) a method was explained for tabulating 42 characters so that they could be represented by six signals and a simple miniature apparatus described for transmitting these signals over short distances.

These small instruments can be used to pass messages from room to room or between neighboring houses, and will serve in familiarizing the alphapet and training the operators for more extensive work.

To enlarge the field of operations it is necessary to increase the size of the instrument so that its signals may be seen at a greater distance, and to arrange the larger parts so that they may be conveniently manipulated.

Radial Arm Apparatus.

In Fig. 3, is shown a large instrument which is most readily suggested by the small instrument before described. P is a vertical post about 12 feet high with a

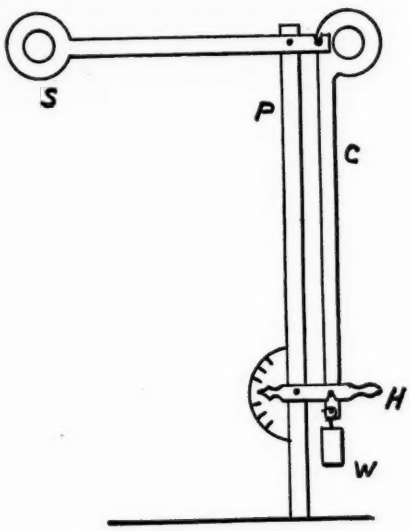

Fig. 3.

signal arm S attached near the top by a lag screw passing through the arm and firmly screwed into the post. The signal arm turns freely upon the screw, so that it may be swung to any desired angle. The outer end of the arm is enlarged and of circular form as shown. The length from centre of disc to screw should be about 6′ and the end beyond the screw about 1′. The disc may be about 18″ in diameter with an 8″ hole. The hole serves to reduce the wind resistance and for night signaling a lantern can be tied to the disc so that it can be seen from either side.

To the short end of the swinging arm is attached a vertical connecting rod C. This rod has at its upper end a disc of the same size as that upon S. The connection between C and S is by means of a lag screw set in C which catches into a deep notch in S as shown.

At about 3′ from the ground, a handle H is screwed to the post and a deep notch in the under side of the handle engages with a lag screw projecting from the lower end of the connecting rod as indicated. The other end of the handle is formed into a pointer which swings around a graduated arc. A weight W, attached to the connecting rod to counterbalance the weight of the signal arm, completes the necessary parts of this device. It will be readily seen that any motion of the handle H, produces a corresponding motion of the signal arm S and that by the proportion of parts, the arm has a much greater motion than the handle. The proper position for the signal can be accurately determined by the position of the pointer on the scale. When necessary a lantern can be attached to the disc upon C the same as upon S and the relative position of the two lights clearly indicates the signal at a distance even though the frame work cannot be seen.

Two weights can be provided for W according to the use of the apparatus with or without lanterns. The use of notched connections upon H and S permits the connecting rod to be entirely removed when not in use and allows S and H to drop out of the way in a vertical position along the post. It is not necessary to follow strictly the dimensions given, but they are suggested as the best for average conditions.

If a special situation requires a greater height of the signal above the operator, it may be secured simply by increasing the height of post and length of connecting rod. If the distance between stations seems to demand a larger instrument it will usually be found more convenient and economical to use a field glass rather than to extend the construction to unwieldy proportions.

Vertical Motion Apparatus.

In Fig. 4 is represented an instrument of about the same range as shown in Fig. 3, but differing in details of construction. The vertical post P is about 16 feet high. A cord, C, runs over grooved pulleys near the top and bottom of the post. Connected with the lower

pulley is a balance wheel W. A signal piece S is attached to the cord, so that the revolution of the wheel W raises and lowers the signal. This signal may be a large light box or a light wire frame of spherical form covered with canvas for day signals and a lantern for evening work.

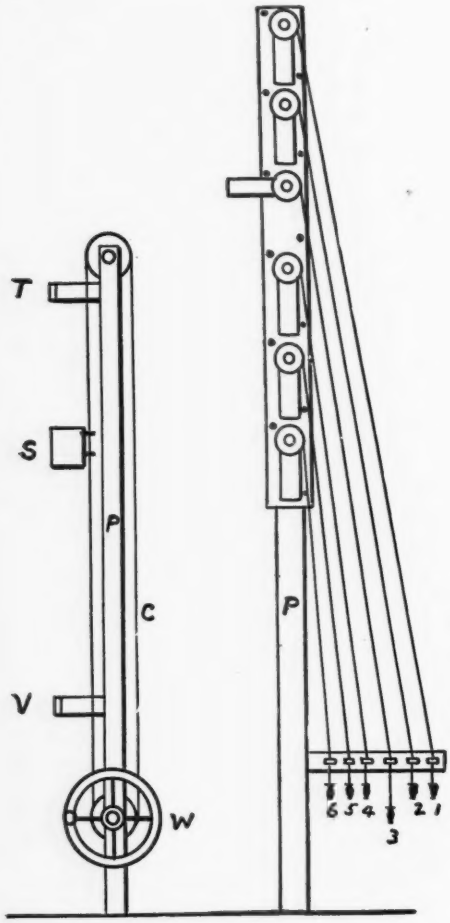

FIG. 4.

FIG. 5.

Stops at T and V limit the motion of the signal and also show the observer what signal is presented. For that reason the stops should be large enough to be seen at a distance, and a cross piece may be nailed across the end of each stop so that it can be seen from the side as well as front or back.

In the evenings, if necessary, a lantern can be hung from each stop. For convenience of operation it is desirable that the diameter of the pulleys should bear some definite relation to the space traversed by the signal. If the pulleys are 7″ in diameter and the space between stops about 8″, and the signal is at the upper stop, one revolution will bring it to the second position, two revolutions to position three, and so on. Second hand or stock pulleys and a balance wheel can be picked up in almost any locality. If the wheels are small it may be arranged to make each space by two revolutions. The space between stops can be varied considerably to accommodate the available supplies.

For use with the alphabet already described, the position of the signal at the top indicates 1, a little below this 2, a little above central position 3, and so on to the lowest position 6.

When a special situation requires an unusual height of the signals above the operator it can be secured by lengthening the post and increasing the length of cord and distance between V and W. This apparatus cannot be worked quite as rapidly as that with the radial arm, but is more compact and can be seen from all points of the compass.

MULTIPLE ARM APPARATUS.

The principle of this instrument is clearly indicated in Fig. 5. Six swinging arms are placed between two boards at the top of post P. The front board is removed to show the construction. Each arm is provided with a small grooved pulley upon a suitable point of which is attached the end of a cord. All these cords are carried to the arm near the base of the post, where they pass through screw eyes which hold them in position. Each cord terminates in a handle of sufficient weight to hold the cord taut.

Around each of the arms two stops are provided to limit its motion, one preventing it from swinging higher than a horizontal position and the other stop catching it when it drops to a vertical position. These stops may be small rods extending from one of the frame boards to the other and tying them together. The six arms represent the signals from 1 to 6, the upper arm representing 1 according to the code. Hence, by pulling one of the handles, as 3, the corresponding arm is instantly swung into position.

This apparatus is necessarily more complicated than those previously described, and for night signaling requires six lanterns, with possibly two additional lights, to indicate the relative position of the moving lights. But it has the obvious advantage that each signal can be instantly displayed, and 1 followed by 6 takes no more time than 1 followed by 2. Double figures can also be displayed without difficulty simply by two motions of the same arm.

The producers of alcohol in France are somewhat disturbed because of the new invention by which alcohol is manufactured by synthesis by means of acetylene.

THE BOOK-SHELF.

MODEL ENGINES AND SMALL BOATS. Nevil Munroe Hopkins, D. Van Nostrand Co. New York. 74 p. $1.25.

THE author presents in the first chapter the simplest form of a small model single acting oscillating type of engine and describes each part so fully that the novice will have no difficulty in following the directions. A simple form of slide valve engine is then given with ample detail and also a reversible-screw engine suitable for model boats. Model boilers, of both sheil and water tube type, suitable for supplying steam to the engines, are well presented, making the book an excellent one for those desirous of making a start in model engine and boiler work. The style of construction followed is one that calls for only a moderate tool equipment, an important point with many beginners. A chapter is also devoted to elementary boat design, including a system of hull construction, using wooden ribs in combination with card board plating, which the author states has given entire satisfaction under trying circumstances. The many excellent illustrations fittingly supplement the text.

SMALL ENGINES AND BOILERS. Egbert P. Watson, D. Van Nostrand Co. New York, 108 p. $1.25.

THE intention of the author in writing this book has been to present specific directions and correctly designed plans for small engines and boilers, ranging from models up to workable engines of 5 H. P. with instructions for calculating and laying out other sizes than those given. The importance of having boilers of adequate steaming capacity is forcefully presented. The constructive work required is of a rather higher order, but not more difficult, than that commonly called for in small engine literature, and for that reason, is highly commended to the reader who is desirous of constructing working engines of small power.

THE ARITHMETIC OF THE STEAM ENGINE. E. Sherman Gould, C. E., D. Van Nostrand Co. New York. 77 p. $1.00.

The young engineer who has constructed one or more model engines and desires to know something of the fundamental principles of the steam engine will find this volume a most desirable one. Without entering into the more abstruse mathematics of the subject, all is given that is necessary to solve the ordinary problems relating to steam in its applications to the steam engine. It is a judiciously selected collection of facts and rules presented in a readily accessible shape making it of much practical use to the student, either professional or amateur.

A PRACTICAL COURSE IN MECHANICAL DRAWING. William Fox, M. E. and Charles W. Thomas, M. E., D. Van Nostrand Co. New York. 98 p. $1.25.

THE readers of this magazine who have been interested in the chapters on mechanical drawing which have been presented, will find in this book much valuable information which would fittingly supplement that already given. All instruction is given in connection with concrete exercises most excellently selected and illustrated. Many photographic reproductions add a clearness to the presentation of the subject rarely attained and the book cannot be too highly recommended. Teachers of manual training classes will find the exercises of especial value, as would the student who is studying without a teacher.

CORRESPONDENCE.

OUR readers are invited to contribute to this department, but no responsibility is assumed for the opinions expressed in these communications.

Letters for this department should be addressed to Editor of AMATEUR WORK, 63 Kilby Street, Boston.

They should be plainly written on only one side of the paper, with a top margin of one inch and side margins of one-half inch.

The name and address of the writer must be given, but will not be used, if so requested.

Enclose stamps, if direct answer is desired.

In referring to other letters, give the number of the letter referred to, and the date published.

Illustrate the subject when possible by a drawing or photograph with dimensions.

Readers who desire to purchase articles not advertised in our columns will be furnished the addresses of dealers or manufacturers, if stamp is enclosed with request.

(No. 27) PITTSFIELD, MASS., NOV. 10, 1902.

I have just finished making the Wimshurst machine described in the April number and have succeeded in getting only a 1-4 to 3-8 inch spark. With the condensers attached I get a spark of the same length but very bright and with a report. This does not come up to the claims made in the description. When my machine is in operation, there is much sparking at the brushes and sparks can be seen escaping from the tinfoil sectors on all parts of the plates, giving light enough to light up the machine when in a dark room. I enclose a sample of the sectors used and also a piece of the copper used for the brushes with a cut made to show the size of the strips of which there are 15 in each brush. 1. Are these of the right materials? 2. How far should the collecting combs be from the plates? should they be as near as possible? Mine are about 5-16 of an inch away from plates. 3. If the materials used for sectors and brushes are not right please advise where I can obtain the correct kind. W. G.

1. The foil is much too thin and the copper much too thick. A sample of suitable foil is enclosed with this answer. The brushes should be made of very thin tinsel to form a quite flexible brush, otherwise the brushes will scratch the sectors and at best, not operate properly. 2. As close as possible without touching. 3. The Knott Apparatus Co. Ashburton Pl. Boston, have heavy tin foil at 50 cents per pound. one half pound being a sufficient quantity. Postage would be extra, 8 cents. Sufficient tinsel for several brushes may be obtained of the same firm for 25 cents. Your machine will undoubtedly operate to your satisfaction when you have made the necessary changes. As you will have to change the sectors, for a trial use a good photographic paste for attaching them to the plates, instead of shellac as given in the description. A tin tube of paste can be obtained at any stationery store for 5 cents.

(No. 28.) CLEVELAND, OHIO, NOV. 6, 1902.

1. In making a Wimshurst machine, will plates 1-4″ thick generate more electricity than 1-8″ plates? 2. Would the machine with pads produce more with the 1-4″ plates? 3. How can I mount three plates 1-4″ thick, two of which are 15″ in diameter and the other 18″? Would it be safe to mount two such heavy plates in the manner described in No. 6 of this magazine? 4. Should the middle plate stand still or go in the opposite direction to the other two? 5. Would tin foil have to be put on the middle plate? if so, on one side or both? Should the tin foil on the outer plates face the inner plate or be on the outside? 6. Should the "brushes" and "collectors" go between the two outside plates and the inside plate or outside the outer plates or in both places? H. C.

1. The thicker plates are less efficient than the thinner ones. 2. No difference. 3, 4, 5, and 6. A poor method of construction, the two outer plates neutralizing each other. This type of generating machine is designed to use plates in pairs and adding an odd plate would interfere with its efficiency. It is advisable to keep to the forms which able and experienced scientists have developed and found most practical, changes being made only for purposes of experiment.

(No. 29.)

MONSON, MASS., NOV. 29, 1902.

After reading the description of the kerosene burner in the November number, I am prompted to ask the following questions: Do you have to put anything over the grates to make it airtight, as in some commercial heaters? Do you use a fine or coarse blade on hack-saw to cut the slots? I shall probably make a burner as described and if well satisfied with it, make one for my boiler; a small horizontal return flue boiler, 2′ diameter and 5′ long. Grates are 28″ long. Think I could make mixers 24″ long and wish to know diameter to use, size of feed pipe and hole for air inlet. Do you think it would give sufficient heat to run boiler? About how much oil does the stove burner consume in a day? W. C. M.

Nothing is required between grate and burner. Use a fine hack-saw for cutting the slots, so the latter will be as thin as possible. Do not recommend this type of burner for a boiler, as it is not an economical type to use for that work.

A suitable burner for boilers is now being investigated, and will be described in these columns if one is found. The consumption of oil in the burner, as described, varies greatly with the party using it, but an estimate might put it at 1 1-4 gallons in 10 hours with both sides being used.

(No. 30.)

NORTHAMPTON, MASS., DEC. 3, 1902.

In the November number is an article concerning the making of an oil burner for a stove. I have a heater boiler in which I would like to use a burner of this description and wish to ascertain the proper dimensions of pipe required for same. Fire pot is round four measures about 23″ in diameter. Is it advisable to separate the mixers? i. e. if two mixers are used, would it be well to place them two or three inches apart? G. S. W.

The burner described in the November number of this magazine is not recommended for use in a boiler, as it would be difficult to utilize the heat in an economical way. The subject of a suitable burner for boilers is now being investigated, and if a pattern is found which is satisfactory, a description will be published of the same.

(No. 31.)

MOOSUP, CONN., DEC. 1, 1902.

Will you please tell me where I can get the lead used in the construction of the storage cell described in May number of Amateur Work. And do you have to charge it with a dynamo or batteries? How long do I have to boil the cover in paraffine? H. G. P.

The leads for the storage cell described in the May number of this magazine, you will have to make yourself, as they are not on sale by electrical supply dealers. You can easily make a mould from wood and pour them, being careful to get pure lead, which preferably should be purchased in pig form. The battery may be "formed" by a battery and can be charged by either battery or dynamo, preferably the latter. The cover is boiled in paraffine for a few minutes after bubbles cease to rise to the surface.

Renew your subscription promptly.